

Edition 1.0
Feb. 22, 2005

EZ-USB-168

User manual

FCC COMPLIANCE STATEMENT FOR AMERICAN USERS

This equipment has been tested and found to comply with the limits for a CLASS A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

EMS AND EMI COMPLIANCE STATEMENT FOR EUROPEAN USERS

This equipment has been tested and meet the requirements relating to electromagnetic compatibility based on the standards EN50081-1 (EN55022 CLASS A) and EN61000-4-2/-3/-4/-5/-6/-8/-11 (IEC Teil 2,3,4). The equipment has also been tested and is verified to be within the European Standard EN55022 for the both Radiated and Conducted emissions limits.

Specifications are subject to change without notice.

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Chapter 1 The USB Inspector

1-1 introduction

The EZ-USB-168, which is also called as “USB Inspector”, is a debugging tool used for intercepting on-line USB signal of any USB 1.1 compliant device by inserting it between the host and USB device through two USB cables. The tool can extract the USB protocol without interrupting the operation, that is, when the USB device is operating with the host PC. After properly decoding the filtered-out USB signal from the USB cables, the EZ-USB-168 Inspector transfers the signal to the same or another PC by using another USB port. When the driver program in the PC receives the coded data from the Inspector, it will display the data on the monitor for you to analyze and debug. The major features of the EZ-USB-168 are as shown below:

- ◆ Complies with the USB1.1 Full Speed & Low Speed specification.
- ◆ Auto-detects Full Speed & Low Speed.
- ◆ 512K X 8 bits SRAM included.
- ◆ Uses USB1.1 port to communicate with the host PC and does not need extra power to operate.
- ◆ Compact size, easy to carry, and saves space.
- ◆ Easy installation and usage.

1-2 What You Should Get?

The standard shipment of the EZ-USB-168 Inspector should consist of the following components packed in a box:

- ◆ A main frame.
- ◆ Two USB cables (1M and 1.8M).
- ◆ A compact disk containing the driver, application and user manual.
- ◆ A warranty.

1-3 Specification

Package	Size	L X W X H = 14.60cmX9.60cmX2.50cm	
	Weight	325g	
	Socket 1(HOST1)	USB 1.1"B" Receptacle	
	Socket 2(HOST2)	USB 1.1 "B" Receptacle	Note 1
	Socket 3(DEVICE)	USB 1.1 "A" Receptacle	Note 1
	Cable 1	1.0M USB 1.1 ("A" Plug + "B" Plug) cable	
	Cable 2	1.8M USB 1.1 ("A" Plug + "B" Plug) cable	
Power	VBUS	4.75V~5.25V	
	Current Consumption (Normal)	90 mA	
	Current Consumption (Record)	100mA	
Record Memory Size	SRAM	512K X 8 bits	
Switch	Reset	Reset System	
LED	POWER	Lights up when inspector is powered on	
	ERROR	Lights up when inspector cannot be initialized correctly	
	CONFIG	Lights up when inspector is normally configured	
	RECORD	Lights up when inspector is recording USB signal	
Transfer Mode	Socket1 Transmission Mode	USB 1.1 Full speed Control and Bulk mode	
	Socket2 & Socket3 Transmission Mode	Any one of the USB 1.1 transfer mode	
Operation Environment	Operating Range	5°C to 40°C	
	Storage Range	0°C to 80°C	
	Humidity	10% to 90%	
Certification		CE, FCC Class A	
Product Warranty		Elan offers one-year limited warranty	

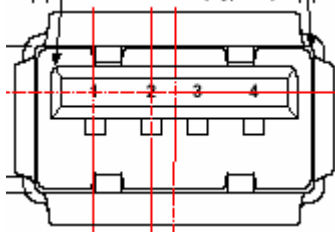
Table 1-1

Note1: Please see "section 1-4 the USB specification" to rightly choose the cable.

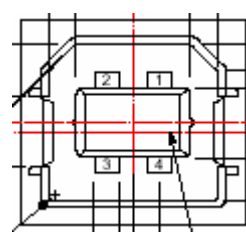
1-4 The USB Specification

Connector type

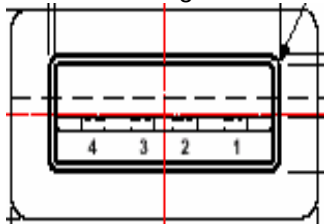
TYPE A-> Receptacles



TYPE B-> Receptacles



TYPE A-> Plug



TYPE B-> Plug

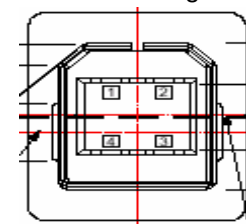


Figure 1-1:EZ-USB-168 Connectors

Contact Number	1	2	3	4	Shell
Signal Name	VBUS	D-	D+	GND	Shield

Table 1-2

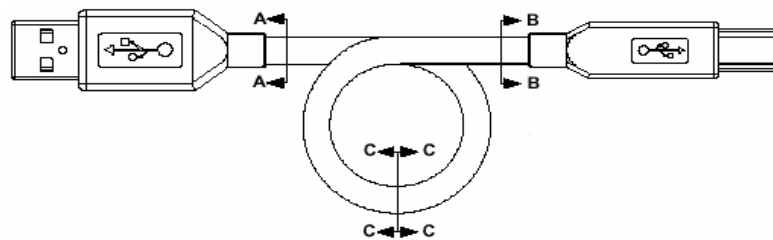


Figure 1-2:EZ-USB-168 Cable

Chapter 2 Installation

2-1 Hardware's Requirement

IBM PC Pentium IV Speed 650Mhz
128M bytes RAM
Two USB 1.1 ports
A 1024X768 monitor
A CD ROM

2-2 Hardware's Installation

Figure 2-1,2-2,2-3 show USB Inspector outlook from different view.

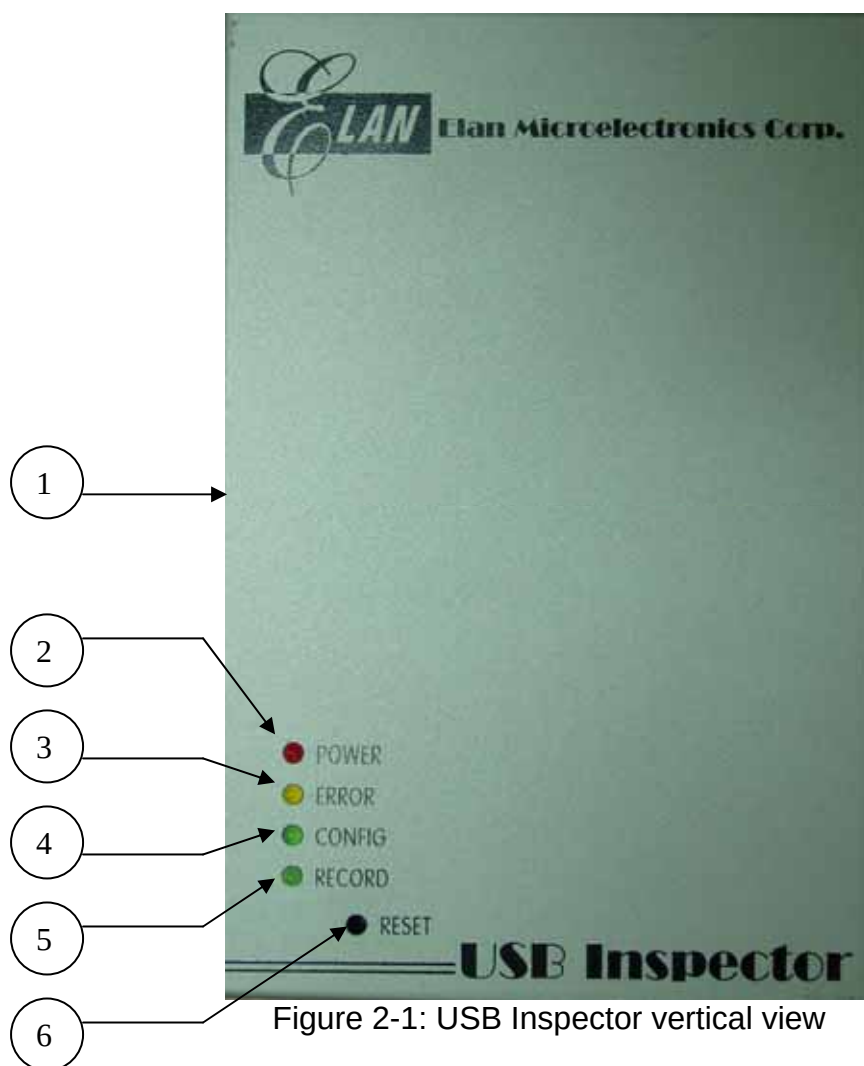


Figure 2-1: USB Inspector vertical view

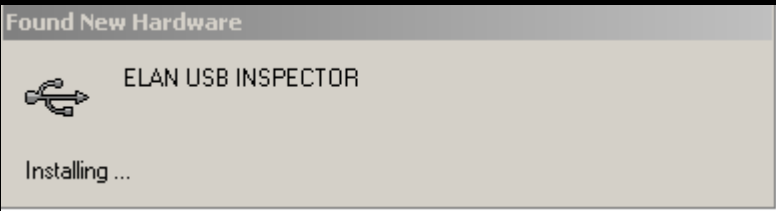
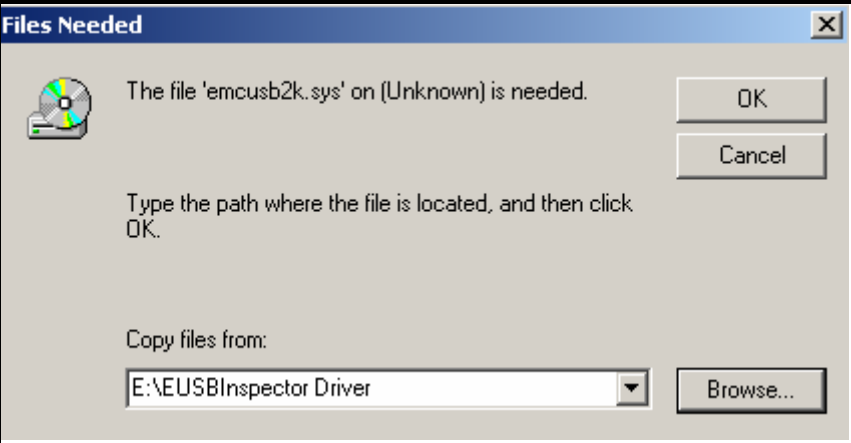
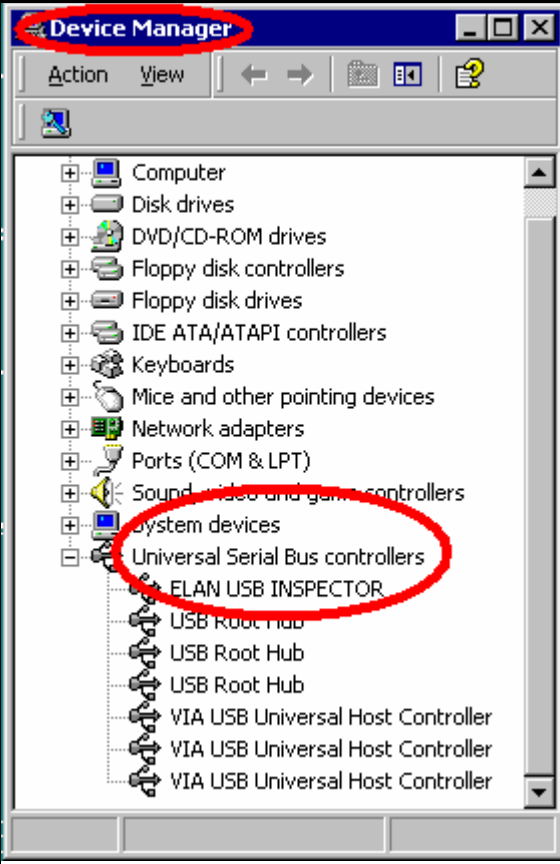


Figure 2-2: USB Inspector lateral view 1



Figure 2-3: USB Inspector lateral view 2

- | | |
|-----------------|-------------------------------------|
| 1. MAIN MACHINE | |
| 2. POWER | System power indicator |
| 3. ERROR | System function error indicator |
| 4. CONFIG | Normal operation indicator |
| 5. RECORD | USB signal record indicator |
| 6. RESET | To reset system |
| 7. HOST1 | Use for communication with PC |
| 8. HOST2 | Connector for Testing PC |
| 9. DEVICE | Connector for the Device Under Test |

STEP1	Turn on PC and wait for the Windows OS to be ready. Connect the USB cable to the inspector HOST1 socket and the PC's USB port. Windows will show finding new hardware.
STEP2	Windows recognizes ELAN USB INSPECTOR. 
STEP3	Choose driver source by press browse button.(In your CD-ROM Device: \\EUSBInspector Driver\\) And press OK to continue. 
STEP4	Then, you can see the ELAN USB INSPECTOR icon is displayed under Universal Serial Bus controllers in Device Manager. 

STEP5	After completing installation correctly, the inspector's POWER and CONFIG LEDs should be lighted on. If not, see the troubleshooting to the solution.	
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Troubleshooting:

If you can not complete the hardware installation, check by following steps:

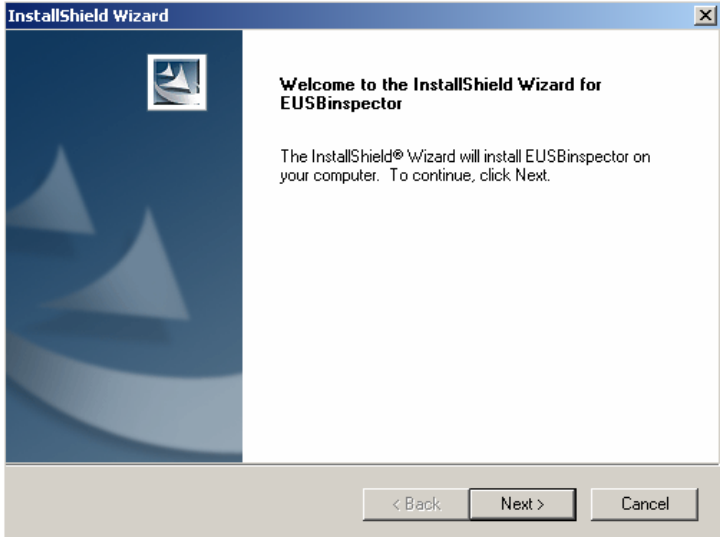
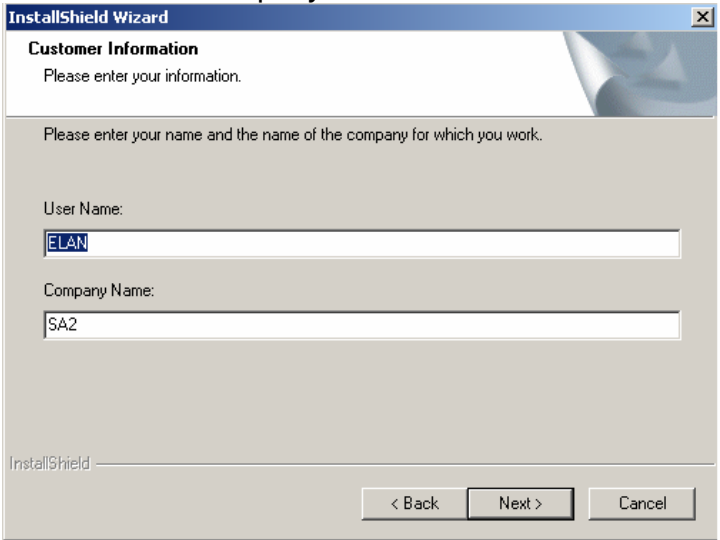
1. When inspector is connected to PC, check its red LED (POWER). If it is dark, the inspector is not rightly powered.
2. Check the yellow LED (ERROR). If it is lighted, the inspector hardware can not be normally initialized. Press reset button. If it is still lighted, the inspector has some problems in it. Contact Elan for support.
3. The green LED (CONFIG) should be lighted when inspector is normally initialized. If it is dark, the FPGA on the inspector has problem. Contact Elan for support.
4. If the red LED (POWER) and green LED(CONFIG) are lighted and yellow LED(ERROR) is dark, the inspector system is already normally initialized. When the Windows can not recognize the inspector, you may pull it out from the cable and plug it again to let the USB host controller to do enumeration again. If it still can not be recognized by Windows, contact Elan for support.

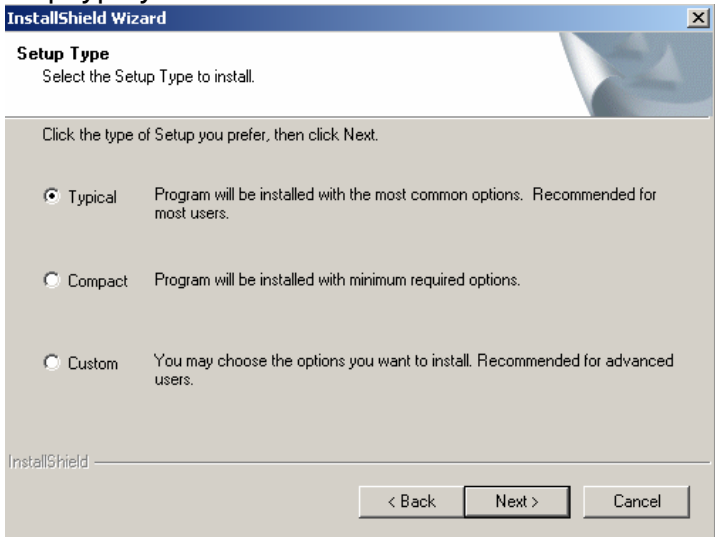
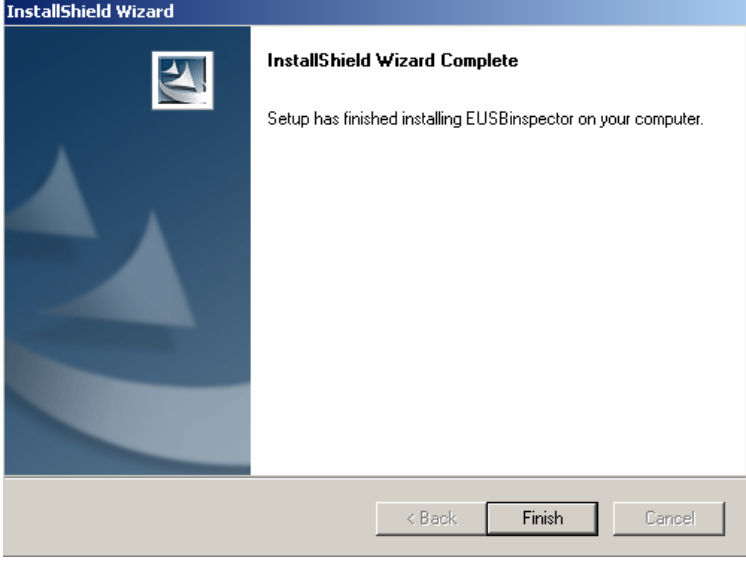
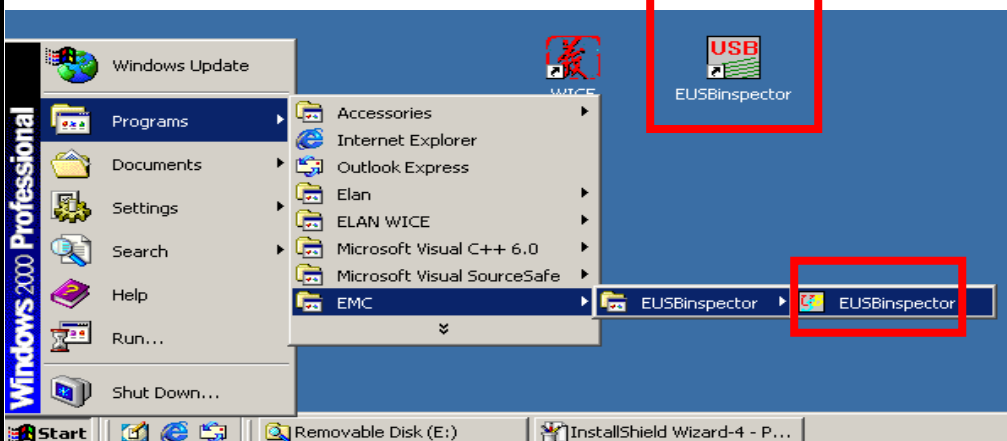
2-3 Software's requirement

The application, EUSBInspector, of the EZ-USB-168 is designed to operate under Windows OS. You must have one of Windows 98, Windows Me, Windows NT, Windows 2000, or Windows XP in your computer to run it.

2-4 Software's Installation

Please take out the bundled CD from the package and then insert it into the CD-ROM drive of your computer. Follow the step-by-step procedure listed below to install the driver program.

STEP 1	Execute the EUSBInspectorVer1.0.exe program from the CD.
STEP 2	Then InstallShield wizard will guide you to install EUSBInspector software. 
STEP 3	Input your User Name and Company Name. 

STEP 4	Choose the setup type you want.  The screenshot shows the 'InstallShield Wizard' window. Under the 'Setup Type' section, there are three radio buttons: 'Typical' (which is selected), 'Compact', and 'Custom'. Each option has a description. At the bottom, there are buttons for '< Back', 'Next >', and 'Cancel'.
STEP 5	Click the Finish button in the dialog box to complete the installation.  The screenshot shows the 'InstallShield Wizard Complete' window. It states 'Setup has finished installing EUSBinspector on your computer.' At the bottom, there are buttons for '< Back', 'Finish', and 'Cancel'.
STEP 6	You can see the icon & shortcut “EUSBinspector” in you desktop and Start menu. Click it to Run...  The screenshot shows a Windows XP desktop. On the desktop, there is a folder icon labeled 'USB' and a file icon labeled 'EUSBinspector'. The 'EUSBinspector' file icon is highlighted with a red rectangle. In the Start menu, which is open, there is a list of programs. Under the 'EUSBinspector' entry, there is a sub-menu with a single item 'EUSBinspector', which is also highlighted with a red rectangle.

Chapter 3

Getting Started with the Inspector

Please be sure that the procedure in Chapter 2 “Installation” has been satisfactorily completed before continuing.

In order to get a full understanding of how the tool function and process USB signals, the following topics are further provided.

3-1 Introduction

The key function of our EZ-USB-168 USB Inspector is to capture the USB signals in the USB cable and extract the high level protocol from them. The EZ-USB-168 captures the USB electric signal when the Device Under Test is communicating with the host PC. After proper decoding of the low level USB signal, the packet data are sent to the host PC. The application, EUSBinspector, in the host PC transforms the packet data into readable format and displayed on screen for you to trace, analyze, and debug during development of your USB devices. It is recommended that you must be familiar with the USB 1.1 specification before using the EZ-USB-168 USB Inspector so as to get into the bottom of the tools.

3-2 Starting with EUSBinspector

Make sure that the EZ-USB-168 USB Inspector and the PC are properly connected before you start the driver program.

To start the program, double click the ICON on the desktop or execute the program “EUSBinspector.exe” under Windows. The following window (Figure 3-1) will then display.

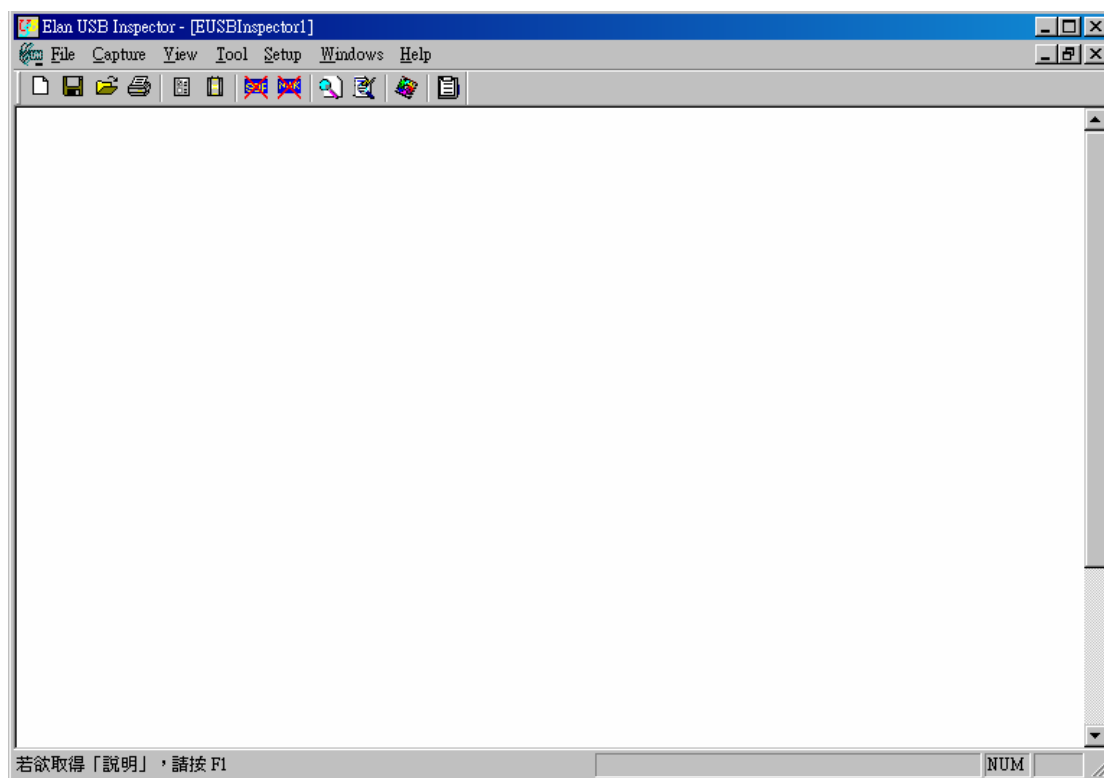


Figure 3-1: EUSBinspector Main Window

If error occurs, the error message shown below will display. Please double-check all connectors to and from the EZ-USB-168 for proper connections.



Figure 3-2

There are six items File, View, Capture, Tool, Setup, and Help in the Menu Bar of the main window (Figure 3-1). Each item contains pull down menus providing easy to locate commands for quick execution. The following section will give you a brief summary of the commands within each Menu Bar item.

3-2-1 [File Menu] File Management

The commands from the [File Menu] include "New," "Open," "Save As," "Print," "Print Preview," "Print Setup," and "Exit" (Figure 3-3).

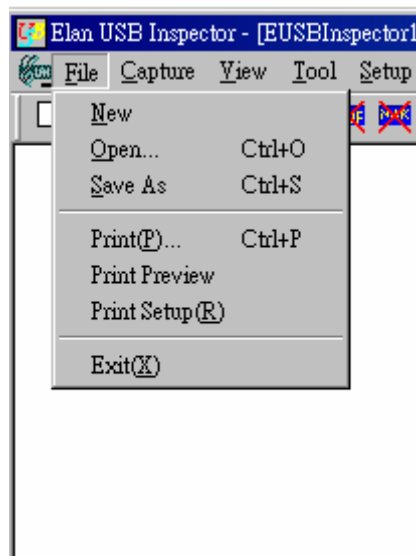


Figure 3-3:File Menu

Each of the commands are explained below:

<u>O</u> pen	Function: It is used for opening the captured files stored in the disk. The default extension of the file name is *.usb.
	Details: The EZ-USB-168 can capture USB signals and then transmit them to the PC. The EUSBinspector will save them in the memory. Subsequent capture and

saving of the USB signals will overwrite the previous data saved in the memory. If you want to keep the previous data for future use, you have to save them to disk first with the Save As command. Open command can retrieve them from the disk.

Operation: Click the Open command and then the Open dialog box will appear (Figure 3-4).

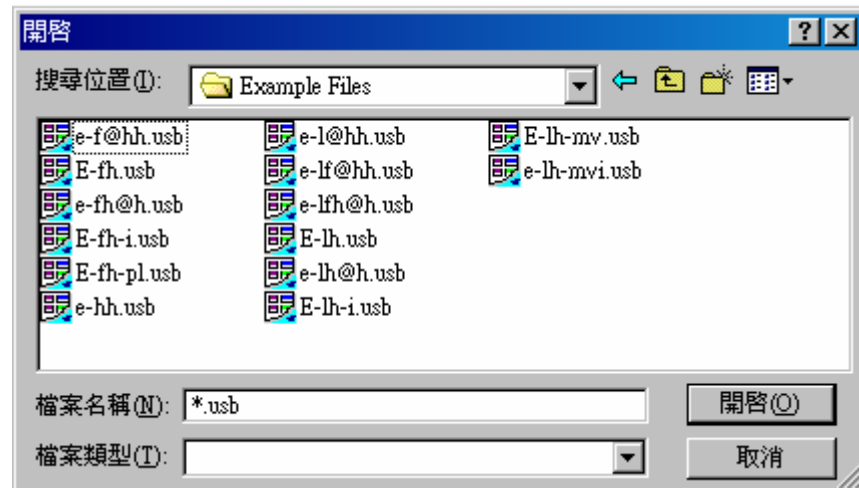


Figure 3-4: Open Dialog Box

Select the desired filename (example test.usb), and then click the Open button. The captured data saved under test.usb file is retrieved and shown in a sub-window (Figure 3-5).

Elan USB Inspector - [C:\Program Files\EMC\EUSBinspector\Example Files\e-fh@h.usb]

File Capture View Tool Setup Windows Help

Packet#	Sync	ERROR
1	00000001	0x64
2	00000001	0xF8

Packet#	Sync	IN	ADDR	ENDP	CRC5
6151	00000001	0x96	002	01	0x18

Packet#	Sync	DATA0	DATA	CRC16
6152	00000001	0xC3	04	0x823E

Packet#	Sync	ACK
6153	00000001	0x4B

Packet#	Sync	SETUP	ADDR	ENDP	CRC5
6156	00000001	0xB4	002	00	0x15

Packet#	Sync	DATA0	DATA	CRC16
6157	00000001	0xC3	A3 00 00 00 02 00 04 00	0x6F87

Packet#	Sync	ACK
6158	00000001	0x4B

Packet#	Sync	IN	ADDR	ENDP	CRC5
6160	00000001	0x96	002	00	0x15

若欲取得「說明」，請按 F1

Data Length = 1 Bytes

NUM

Figure 3-5: Open Sub-window

Save As

Function: Save the captured files to the disk. The default file extension is *.usb.

Details: Only one captured buffer is available in the program. Hence the program cannot process two captured data at a time. You must save the captured data in the hard disk for future reference

Operation: Click the Save As command and the Save dialog box will display (Figure 3-6). Key-in a filename and click the Save button to save the captured data.

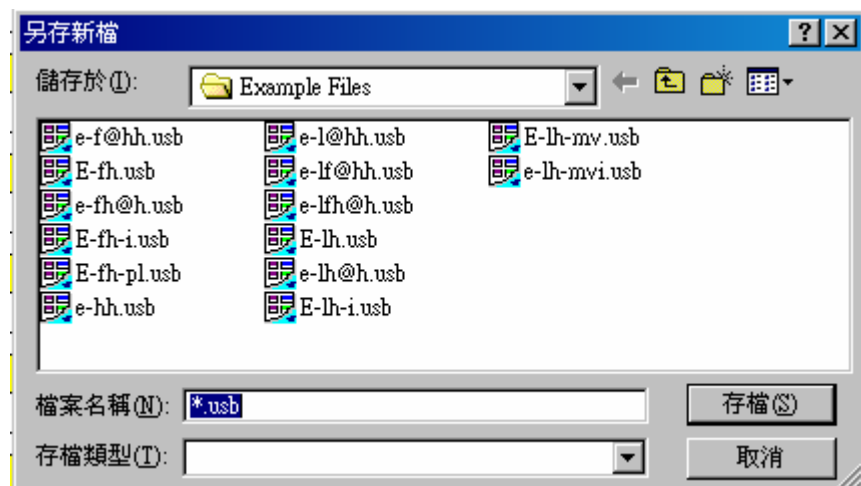
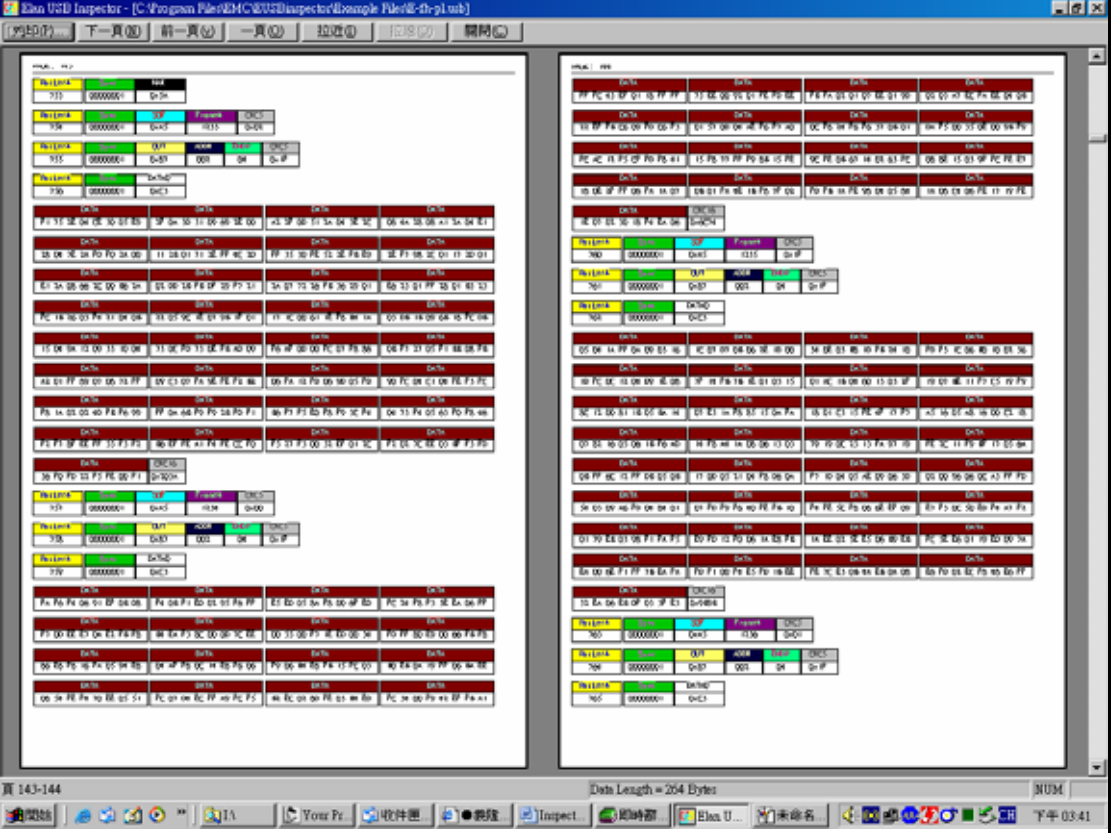


	Figure 3-6: Save Dialog Box
Print & Print preview	Print & Print preview is powerful WYSIWYG tool. Help you to preview and print the captured packets for analysis. 
Exit	Quit from the program.

3-2-2 [Capture Menu] Recording Function

The USB Inspector is designed to intercept the USB signals in the cable that is the major function of the tool. Click on the [Capture] Menu and a resulting drop-down menu will display the Record command (Figure 3-8).

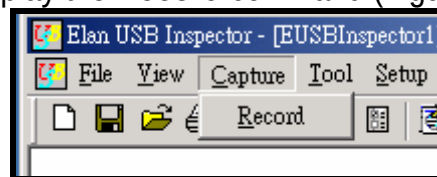


Figure 3-8: Capture Menus

Record	Function: To activate the Capture function. Details: The USB Inspector can detect the signal traffic on the USB line. Whenever it senses any signal on the USB line, the Capture function is activated and the RECORD LED lights up automatically. The Capture operation will be stopped in the two situations: 1. Inspector's buffer is full, 2. User clicks the Stop button. Operation:
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1. Click the Record command and the recording process will display (Figure 3-9).

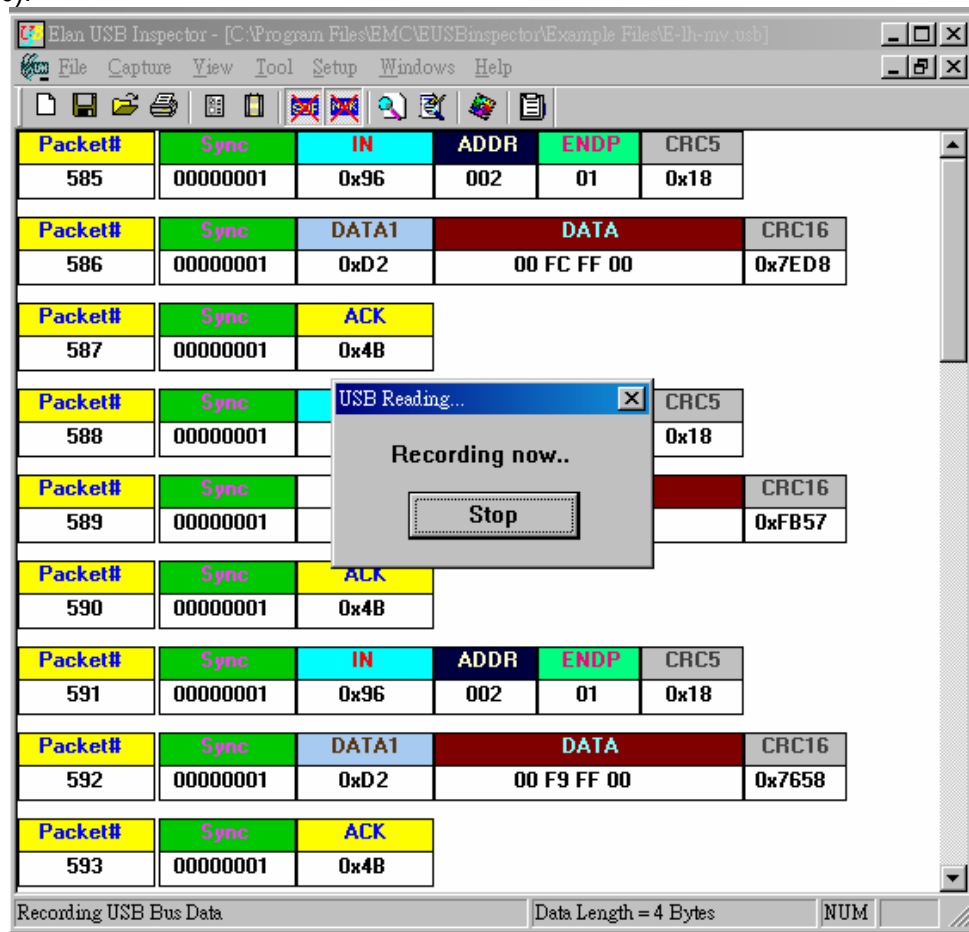


Figure 3-9 "Recording USB Bus Data" Window

2. At the same time a pop-up window showing "Recording now" message appears while the RECORD LED of the tool flashes. Meanwhile, the captured data are stored in the memory. Click Stop button to stop recording if necessary.

3-2-3 [View Menu] View Management

Sometimes, we don't care the SOF or NAK packets. We can hide them in the main window by the command in the View menu "Hide SOF Packets" and "Hide NAK Packets".

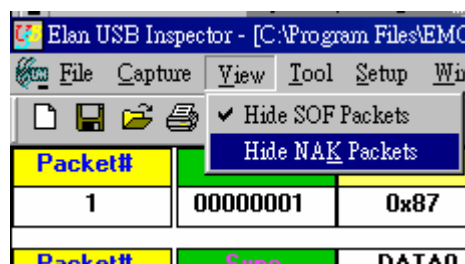


Figure 3-10

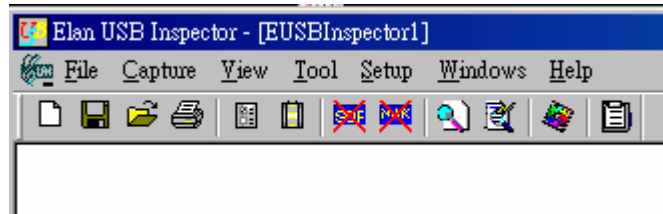


Figure 3-11

3-2-4 [Tool Menu] Tool Box

The purpose of the toolbox is to assist you to dig out the “bugs” hidden in the recorded USB data. The menu offers the Decode Packet, Report, and Search commands (Figure 3-12).



Figure 3-12: Tool Menu

Decode	Function: <u>To decode the setup command</u> Details: Quickly finds the setup token packet with the packet number you key-in and decode the setup command by the USB spec. Operation: Click the Decode Packet command and the Decode Packet dialog box will display (Figure 3-13). Figure 3-13: Decode Packet Dialog Box Key in the packet number you want to search and click OK button.
Report	Function: <u>To report the information of the recorded USB signals.</u> Details: It is very difficult to directly trace the USB signal line by line without any classification. If you preview the statistics' Report, this will help you to quickly understand the recorded USB signal structurally after which it would be easy for you to trace and check the detailed signals. Use this function whenever you have recorded a new USB signals. It can save you a lot of time. Operation: 1. Click the Report command and a USB Bus Report dialog box will appear (Figure 3-14).

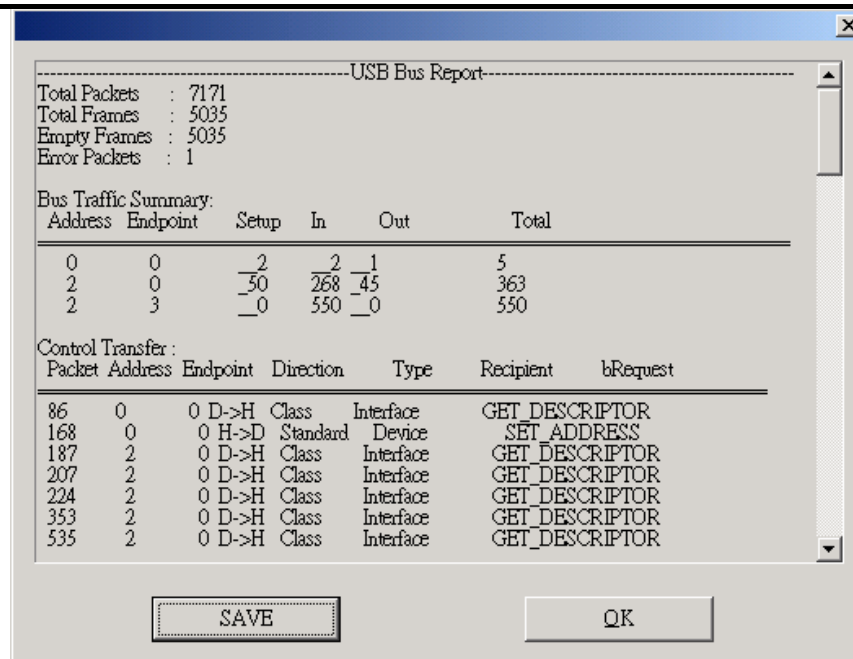


Figure 3-14: USB Bus Report Dialog Box

2. The statistics' report shown on the dialog box is compiled from the last data stored in the PC's memory regardless of whether they were uploaded from the tool or opened from disk files. The contents in the report are arranged in a columnar format for easy reading. More details are provided in Appendix 1.
3. Click **SAVE** button to save the report as a file in general ASCII format. You may later use any text editor (e.g., MS Word, Notepad) to read or edit it. Click **OK** button to quit the function.

Search Function : To search the data by the different method.

Details: For convenient search for data, the EUSBIInspector allows you to search five types of information (i.e., PID, Data, Packet, Address and End point), through the recorded data. Furthermore, you can search from top to bottom of the data or vise versa, to quickly find the match you wanted. The five types of search information are as follows:

Info Type	Format	Remarks
PID	/Setup	-----Search for Setup packet.
	/IN	-----Search for IN Token packet.
	/OUT	-----Search for OUT Token packet.
	/DATA0/DATA1	-----Search Data packet.
	/STALL	-----Search STALL packet.
	/ERROR	-----Search ERROR packet.
DATA	Hexadecimal	Search for specific number in DATA field.
Packet#	Hexadecimal	Search for specific PACKET.

ADDR	Hexadecimal	Search for specific ADDRESS.
ENDP	Hexadecimal	Search for specific End Point.

Operation:

1. Click the Search command and the Search dialog box will appear as shown below:

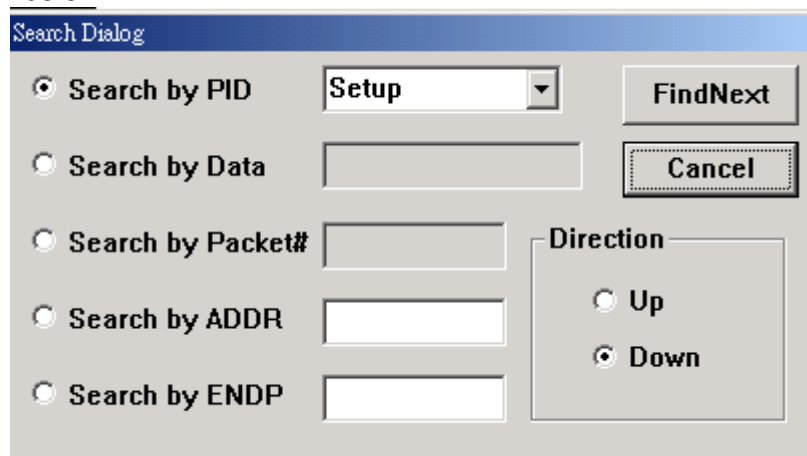


Figure 3-15: Search Dialog Box

2. Click the option button of the desired type of search information. Then click the direction (Up or Down) of the search from the Direction box.
3. Click Find Next button to start search for the first match data. Click Find Next button again to find the next match data, so on and so forth.
4. Click Cancel button to abort or stop the function.

3-2-5 [Setup Menu] Basic Setup Function

This function is for setting up the basic parameters of the tool. It includes the Record Option, Display Setting, and Reset, three basic setting (see Figure 3-16). Details are explained below:

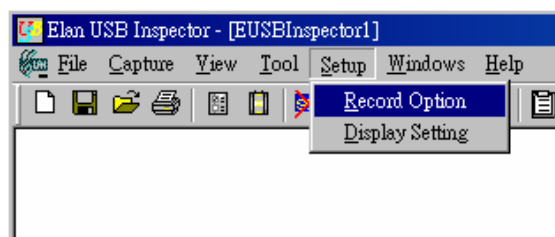


Figure 3-16 Setup Menus

Record Option	Function: Displays the Device Speed and Memory capacity of the tool and controls the idle recording function. Details: The Inspector will automatically detect the speed (full or low speed) of the USB device and shows it in the Status box of the Inspector Setting dialog
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box. The same box also displays the SRAM size of the tool.

Operation: Click Record Option command and the following dialog box appear.

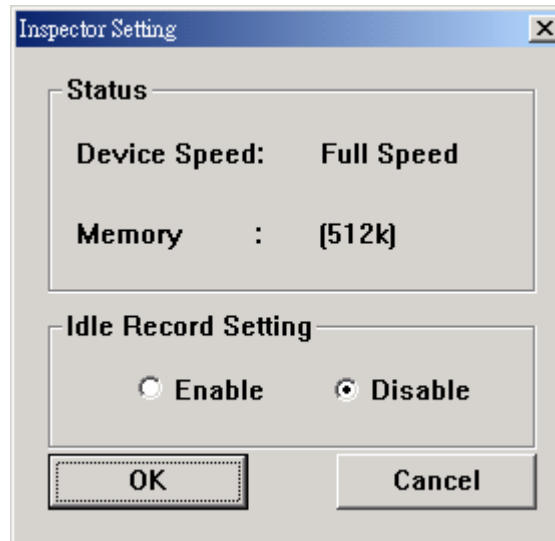


Figure 3-17: Inspector Setting Dialog Box

Display Setting Function : To set the display color of the various fields in the driver program UI.

Details: It is more convenient to distinguish and identify the different names of USB signals when each of them is painted with your favorite color.

Operation : Click the Display Setting command and the dialog box illustrated below (Figure 3-18) will display.

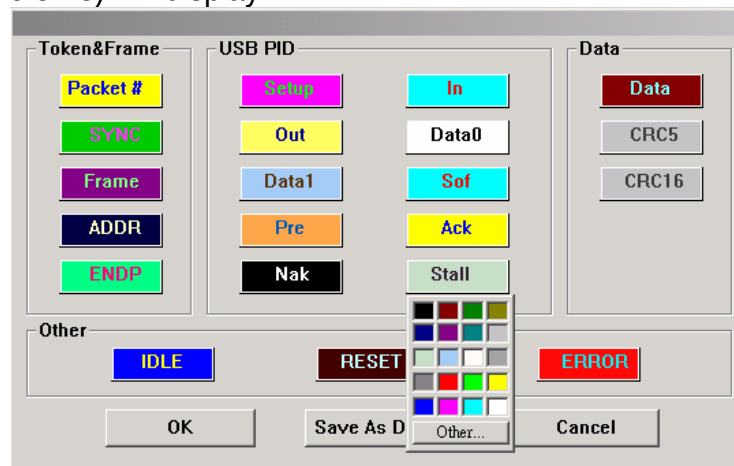


Figure 3-18: Display Setting Dialog Box

1. Point and click at the field, which color you, want to change. Then select one of the colors from the resulting color palette. The newly selected color will show on the field.
2. Click the Save As Default button and the newly selected colors are saved

	into your hard disk. When you run the driver program next time, the last selected and saved colors will be restored from your hard disk. It will continue to reload those colors until they are changed again. 3. If you intend to use the newly selected colors for current session only, click the OK button. Color change is temporary and is not saved in the hard disk. 4. Refer to the Appendix 3 further details of each field.
Reset	Function : Reset the machine。

3-2-6 [Help Menu] On-Line help

It consisted of Help and About for the EUSBInspector (Figure 3-19).

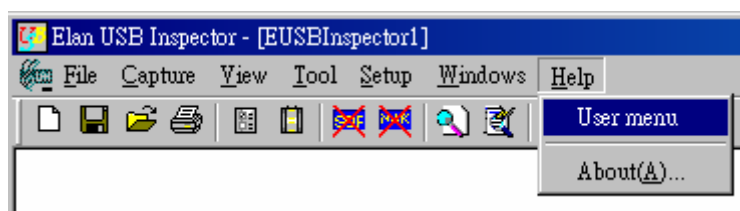


Figure 3-19: Help Menu

Help	Function : On-line help. Description : Provide assistance on how to operate the tool. Operation : Click the Help command and the Help directory will display.
About the USB Inspector	Function : Shows the current version and corresponding copyright of the tool. Operation : Click the command and the dialog box shown in Figure 3-20 (below) will display. A screenshot of a dialog box titled '關於 EUSBInspector'. It contains a USB icon, the text 'EUSBInspector Version 1.0', 'Copyright (C) 2001', and 'Contract: fong.lin@emc.com.tw'. An 'OK' button is located in the top right corner.

Figure 3-20: "About the EUSBInspector"

Appendix

1. Detail Description of the Report

Statistics Column	Fields	Description
Packets & Frame	Total Packets	The summation of the total captured packets.
	Total Frames	The summation of the total frames.
	Empty Frames	The summation of the total empty frames.
	Error Packets	The summation of the total error packets.
Bus Traffic Summary	Address	The assigned address in USB line.
	Endpoint	End point numbers.
	Setup	The numbers of the setup packets with different Address and endpoint.
	In	The numbers of the IN TOKEN with different address and endpoint.
	Out	The numbers of the OUT TOKEN with different address and endpoint.
	Total	The summation of the Setup, In, and Out token.
Control Transfer	Packet	Packet number.
	Address	Assigned address.
	Endpoint	Assigned endpoint.
	Direction	The direction of the Control Transfer. D=Device, H=Host 1. D>H Device to Host 2. H>D Host to Device
	Type	The type of the Control Transfer Standard, e.g., Class, Vendor, etc. Refer to the USB2.0 Specification, Page248.
	Recipient	The type of Control Transfer recipient, e.g., Device, Interface, Endpoint, etc. Refer to USB2.0 Specification, Page 248.
	BRequest	Refer to the USB2.0 Specification, Page 250.

2. Standard Device Requests

bRequest	Description
CLEAR_FEATURE	This request is used to clear or disable a specific feature.
GET_CONFIGURATION	This request returns the current device configuration value.
GET_DESCRIPTOR	This request returns the specified descriptor if the descriptor exists.
GET_INTERFACE	This request returns the selected alternate setting for the specified interface.
GET_STATUS	This request returns status for the specified recipient.
SET_ADDRESS	This request sets the device address for all future device accesses.
SET_CONFIGURATION	This request sets the device configuration.
SET_DESCRIPTOR	This request is optional and may be used to update existing descriptors or new descriptors may be added.
SET_FEATURE	This request is used to set or enable a specific feature.
SET_INTERFACE	This request allows the host to select an alternate setting for the specified interface.
SYNCH_FRAME	This request is used to set and then report an endpoint's synchronization frame.

3. Protocol Layer of USB Specification

Packet

All the USB data transfers are implemented by the element “packet”. A packet is a bundle of field organized in a group for transmission. For USB host and device receiving packet correctly, there is a field called “SYNC” at the beginning of every packet. It is used by the input circuitry to align incoming data with local clock. There is also a field “EOP” used to mark the End-of-Packet.

SYNC	Packet Content	EOP
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Figure A3-1: The sync field and EOP in the packet.

In the USB data transfer, there are 4 types of packets, token, data, handshake, special, in the USB 1.1 specification as shown in the table A3-1.

PID Type	PID Name	PID[3:0]*	Description
Token	OUT	0001B	Address + endpoint number in host-to-function transaction
	IN	1001B	Address + endpoint number in function-to-host transaction
	SOF	0101B	Start-of-Frame marker and frame number
	SETUP	1101B	Address + endpoint number in host-to-function transaction for SETUP to a control pipe
Data	DATA0	0011B	Data packet PID even
	DATA1	1011B	Data packet PID odd
Handshake	ACK	0010B	Receiver accepts error-free data packet
	NAK	1010B	Rx device cannot accept data or Tx device cannot send data
	STALL	1110B	Endpoint is halted or a control pipe request is not supported.
Special	PRE	1100B	Host-issued preamble. Enables downstream bus traffic to low-speed devices.

Table A3-1: PID types

These 4 types of packets are distinguished by the PID field in the packet content. And their formats are different with each other.

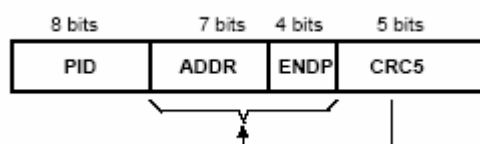


Figure A3-2: SETUP, IN, OUT, token packet format.

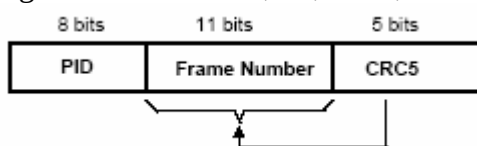


Figure A3-3: SOF packet format

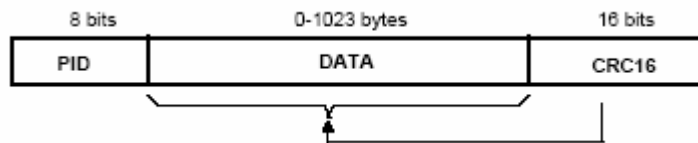


Figure A3-4: DATA0, DATA1, data packet format.

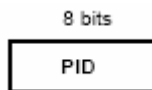


Figure A3-5: ACK, NAK, STALL, handshake packet format.

The PRE (preamble) PID is used when a hub is between the host and the LS device and the host wants to communicate with the LS device. The host will attach preamble before the packet to the LS device. Each time the hub detects the preamble; it discards the preamble and forward the remaining LS packet content to the LS device.

Transaction

In the USB specification, transaction means that a delivery service to an endpoint; consists of a token packet, optional data packet, and optional handshake packet. Specific packets are allowed/required based on the transaction type.

Figure A3-6 shows Control Setup Transaction. The host sends a setup token packet followed by a data packet to issue command to the device. After the device receiving the command correctly, it responses with an ACK handshake packet.

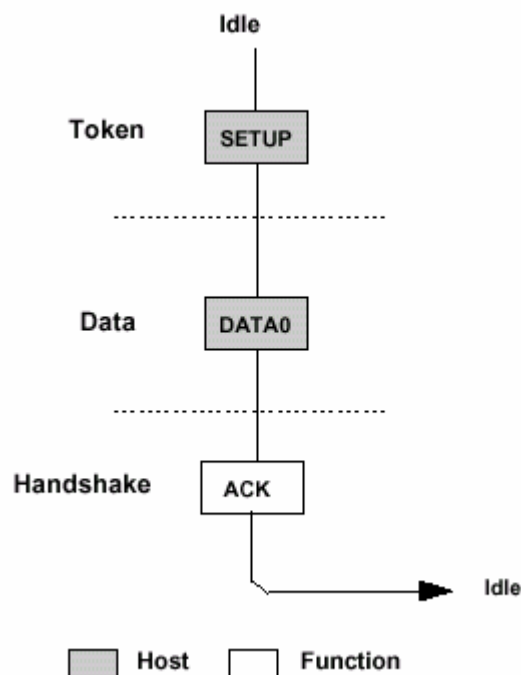


Figure A3-6: Control SETUP Transaction

Figure A3-7 shows Control Read and Control Write sequences. A control write sequence comprises of 3 stages: Setup, Data and Status. The setup stage is a control setup transaction for issuing a command to the device. The data stage comprises a series of out transaction for delivering data to the device. The status stage is an in transaction with empty data packet for completing the control write transfer. A control

read sequence also comprises of 3 stages: Setup, Data and Status. The setup stage is a control setup transaction for issuing a command to the device. The data stage comprises a series of in transaction for delivering data from the device to the host. The status stage is an out transaction with empty data packet for completing the control read transfer.

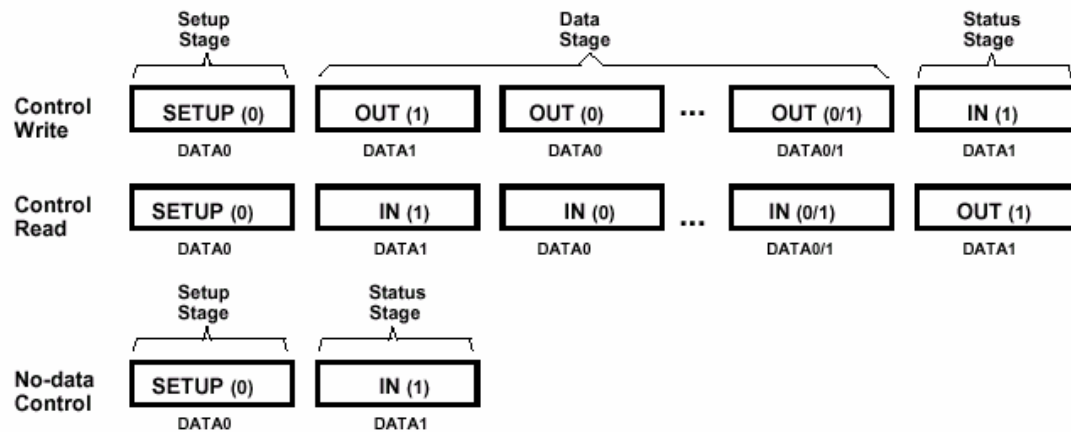


Figure A3-7: Control Read Write Sequence

Figure A3-8 shows a Isochronous Transaction Format. In the isochronous-in transaction, the host sends an in token packet to the device. After receiving the in token packet, the device responses with data packet. In the isochronous-out transaction, the host sends an out token packet to the device firstly and then data packet. In the isochronous transfer, handshake packet is not required.

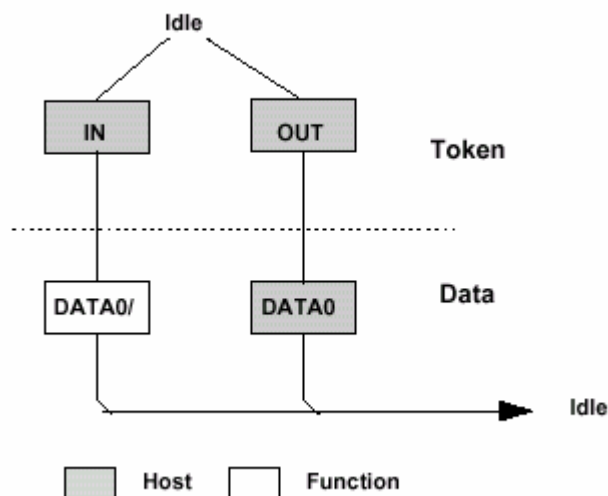


Figure A3-8: Isochronous Transaction Format

Figure A3-9 shows Bulk Transaction Format. In the bulk-in transaction, the host sends an in token packet to the device to request data. The device has 3 response ways: 1. responses with data packet if it is ready to send to the host, 2. responses with NAK handshake packet if it is not ready to send to the host, 3. responses with STALL handshake packet to indicate that endpoint has some problems. In first situation, the host will send an ACK handshake packet to the device after receiving the data packet correctly. If the data packet host received encounters error, the host does nothing. In the bulk-out transaction, the host sends an out token packet to the device followed by a data packet. The device has 4 response ways: 1. responses with ACK handshake

packet if it receives data correctly, 2. responds with NAK handshake packet if it receives data correctly but is not ready to handle this data packet, 3. responds with STALL handshake packet to indicate that endpoint has some problems, 4. does nothing if the data packet received encounters error.

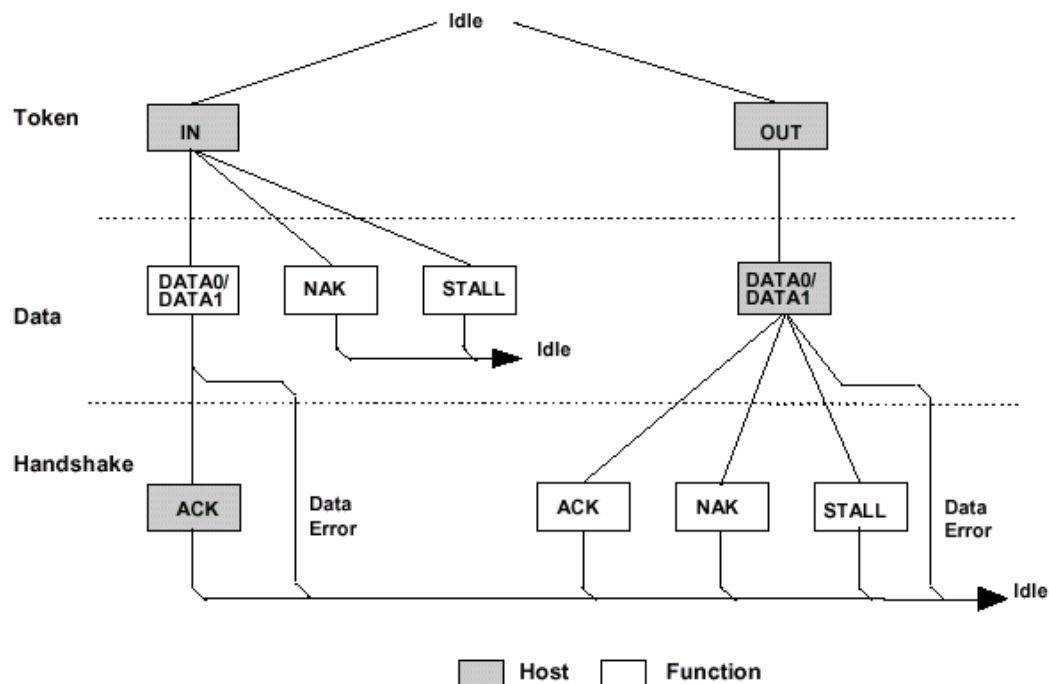


Figure A3-9: Bulk Transaction Format

Figure A3-10 shows Bulk Read and Bulk Write procedure. In the Bulk Read transfer, the host continues to issue bulk-in transaction to request data from the device. In the Bulk Write transfer, the host continues to issue bulk-out transaction to transmit data to the device.

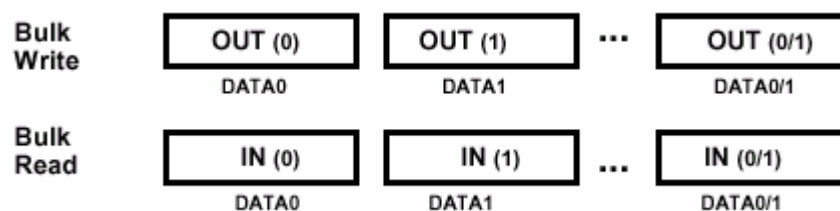


Figure A3-10: Bulk Read and Write

Figure A3-11 shows Interrupt Transaction Format. Basically interrupt transaction is similar to bulk transaction. Generally speaking, interrupt transaction is generated by a regular time interval which is set in the endpoint descriptor.

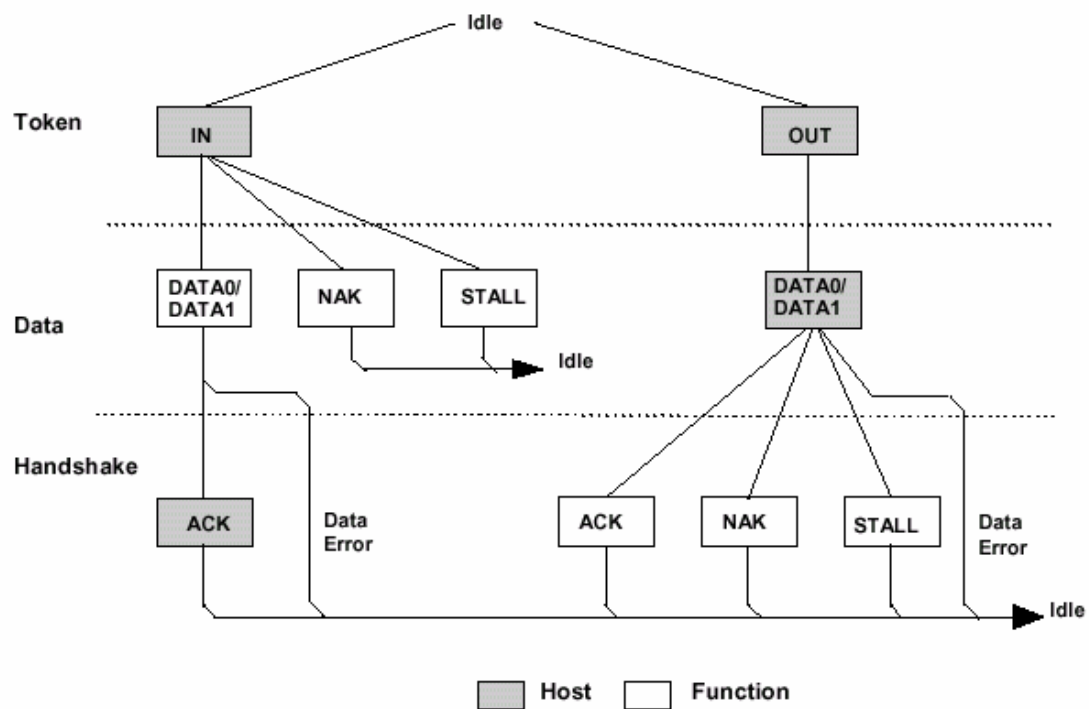


Figure A3-11: Interrupt Transaction Format